

NOMENCLATURAL CHANGES IN NEMACLADUS (CAMPANULACEAE)

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ABSTRACT

Based on morphological and DNA sequence evidence, *Parishella californica* is transferred to *Nemacladus*, and *Nemacladus glanduliferus* var. *orientalis*, *Nemacladus glanduliferus* var. *australis*, and *Nemacladus rubescens* var. *tenuis* are recognized as species. Two new varieties and one new species are named: ***Nemacladus tenuis*** var. ***aliformis***, ***Nemacladus secundiflorus*** var. ***robbinsii***, and ***Nemacladus calcaratus***.

RESUMEN

Basados en pruebas morfológicas y secuencias DNA, *Parishella californica* se transfiere a *Nemacladus*, y *Nemacladus glanduliferus* var. *orientalis*, *Nemacladus glanduliferus* var. *australis*, y *Nemacladus rubescens* var. *tenuis* se reconocen como especies. Se nombran dos nuevas variedades y una nueva especie: ***Nemacladus tenuis*** var. ***aliformis***, ***Nemacladus secundiflorus*** var. ***robbinsii***, y ***Nemacladus calcaratus***.

Nemacladus is an isolated genus in Campanulaceae (Nemacladoideae M.H.G. Gustafsson, Lammers 2007a, 2007b, or Nemacladaceae Nuttall, Takhtajan 1997, which include *Pseudonemacladus* McVaugh and *Parishella* A. Gray) basal to the Campanuloideae and Lobelioideae (Cosner et al. 1994) or sister to a clade comprising Cyphiaceae, Cyphocarpaceae, and Lobeliaceae (Gustafsson & Bremer 1995). Distributed in southwestern U.S. and northern Mexico, extending south to Sonora and Baja California and north into southeastern Oregon and western Wyoming, it is most diverse in California. Filaments connate for part of their length distinguish it from Campanuloideae, free anthers distinguish it from Lobelioideae, and absence of a fluid filled cavity in the stigma separates it from Cyphioideae.

A detailed study of *Nemacladus* has been in progress since the author prepared a treatment of it for the Jepson Manual (Morin & Milburn 1993). Extensive field work, study of herbarium specimens, and, in collaboration with T.J. Ayers at Northern Arizona University, analysis of DNA and study of floral and seed morphology using SEM, have been done for a monograph that is in preparation. In order to reflect the results of this work in the revision of the Jepson Manual in preparation, it is necessary to make some nomenclatural changes in advance of the full monograph.

The monospecific *Parishella* A. Gray, found in the Mojave Desert and disjunct in mountains in Santa Barbara County, California, has long been thought to be the genus most closely related to *Nemacladus* and is here transferred into *Nemacladus*. In ITS (Haberle 1998), and atpB (Ayers in prep.) analysis *Parishella californica* is nested within *Nemacladus*, with closest alliance to *N. rigidus* Curran. As in other *Nemacladus*, large, clear cells are attached to the filaments; the non-resupinate, nearly actinomorphic flowers with white, cup-shaped corolla are similar to those of *N. pinnatifidus* Greene.

Nemacladus californicus (A. Gray) Morin, comb. nov. *Parishella californicus* A. Gray, Bot. Gaz. 7:94. 1882. TYPE: CALIFORNIA.

SAN BERNARDINO CO.: Rabbit Springs, Mohave Desert, Parish 1328, May 1882 (HOLOTYPE: GH! ISOTYPES: MO!, NY!, UC!).

McVaugh (1939) recognized three varieties in *N. glanduliferus* based on their habit and the aspect of the pedicels, considering the flowers to be similar in all three. The flowers differ significantly, however, and these taxa are here recognized as species. *Nemacladus glanduliferus* and *N. orientalis* are sister taxa in the atpB and ITS analysis (Ayers, in prep.).

Nemacladus glanduliferus Jepson has nearly actinomorphic, upward facing flowers that are mostly resupinate, petals white, all similar in size and shape, connate at base forming a cuplike tube, free lobes reflexed;

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filament tube and style erect, arching over flower; capsule hemispheric with base and apex rounded, 2–2.3 mm diameter. It occurs in desert areas of California, Arizona, and northern Baja California and Sonora, Mexico.

Nemacladus orientalis has highly zygomorphic, outward-facing flowers that are not resupinate, petals white with maroon and sometimes yellow markings, free nearly to base, lower two petals longer and narrower than upper three petals; filament tube and style deflexed between lower two petals; capsules hemispheric with base rounded and apex acute, 1.5–2 mm diameter. It is widely distributed in desert areas of California, Nevada, Arizona, Utah, north to Wyoming and south to Baja California and Sonora, Mexico.

Nemacladus australis has highly zygomorphic, outward-facing flowers that are not resupinate, petals white with maroon markings, free nearly to base, lower two petals longer and narrower than upper three petals, filament tube and style deflexed between lower two petals; capsules spherical, 3.5–4 mm diameter. It is known from Rosario, Baja de los Angeles, Santa Catarina, El Terminal, and Sierra Calvario, in Baja California.

Nemacladus orientalis (McVaugh) Morin, comb. et stat. nov. *Nemacladus glanduliferus* var. *orientalis* McVaugh, Amer. Midl. Naturalist 22: 540. 1939. TYPE: NEVADA. CLARK CO.: shore of Lake Mead, near Boulder Dam, 2 May 1938, Percy Train 1566 (HOLOTYPE: NA-no. 52430; ISOTYPE: UNLV!).

Nemacladus australis (Munz) Morin, comb. et stat. nov. *Nemacladus rigidus* var. *australis* Munz, Amer. J. Bot. 11:242, tab. 10. 192. TYPE: BAJA CALIFORNIA. Rosario, 1 May 1886, C.R. Orcutt 1348 (HOLOTYPE: GH!; ISOTYPES: MO!, UC!).

Nemacladus glanduliferus var. *australis* (Munz) McVaugh, Amer. Midl. Naturalist 22:540. 1939

Nemacladus rubescens Greene is one of the most striking species in the genus, with highly zygomorphic flowers and conspicuous markings on the petals. McVaugh named var. *tenuis* based on shape, size, and margins of the basal leaves, size of anthers, and nature of the clear cells attached to the filaments. Except for these characters, he believed the flowers were basically the same as typical *rubescens*. Field studies show that the flowers of *tenuis* are very different from those of *rubescens* and in ways that almost certainly preclude gene transfer between the two, and that there are two different floral morphologies within *tenuis*. *Nemacladus tenuis* is here recognized as a species with two varieties.

Nemacladus rubescens and *Nemacladus tenuis* both have silvery grey stems or reddish stems with a silvery sheen, and yellowish green leaves. *Nemacladus rubescens* has oblanceolate to elliptic, mostly obtuse leaves with entire margins; flowers face outward, are highly zygomorphic, not resupinate, petals divided nearly to base, yellowish with maroon markings, elliptic to lanceolate and straight; filament tube and style declined between two lower petals. *Nemacladus tenuis* has leaves oblanceolate, deeply pinnatifid; flowers face upward or outward, are resupinate, petals yellowish with maroon and yellow markings or white with pinkish or yellowish markings, lower three petals connate at base or divided nearly to base, together bowl-shaped; filament tube and style erect and arching over the flower.

Nemacladus tenuis (McVaugh) Morin, comb. et stat. nov. *Nemacladus rubescens* var. *tenuis* McVaugh, Amer. Midl. Naturalist 22: 536. 1939. TYPE: CALIFORNIA. RIVERSIDE CO.: E base of Indio Mt., Colorado Desert, 17 Apr 1905, H.M. Hall 5819 (HOLOTYPE: US 614929!; ISOTYPES: ARIZ!, DS!, GH!, MO!, NY!, OSU!, P!, POM!, UC!).

Nemacladus tenuis* var. *tenuis

Sepals 0.7–1 mm long, linear; corolla divided 1/2 length, lobes nearly alike; all lobes white with deep pink or yellowish tips, deltate, 0.9–2 mm long; filaments 1–2 mm long, arched, anthers 0.4–0.5 mm long. Mojave and Sonoran Deserts.

Nemacladus tenuis* var. *aliformis Morin, var. nov. TYPE: CALIFORNIA. SAN BERNARDINO CO.: 1 mi E of junction with Hwy. 127 on Old Spanish Gentry Road, 26 Apr 2003, Morin 589b (HOLOTYPE: ASC!).

A *Nemacladus tenuis* (McVaugh) Morin var. *tenuis* sepala anguste deltatus, 2 petalis summa castaneus, angustatus, arcuatus, filis longius, et antherae 0.5–0.6 mm longus differt.

Sepals 1–2.5 mm long, narrowly deltate; corolla divided nearly to base, 2 upper lobes maroon or brownish, linear, arched, 0.9–2.5 × 0.3–0.5 mm long, 3 lower lobes white with yellow and brownish marks, 0.9–2.2 mm long, ciliate; filaments 2–3.5 mm long, anthers 0.5–0.6 mm long. Mohave Desert.

Etymology.—The epithet “aliformis” (from ala, wing, and -formis, with the form of) refers to the winged appearance of the flowers, which resemble small flying insects.

Robbins (1958) helped clarify the circumscription of *Nemacladus* species that have resupinate flowers with corollas that are mostly white or white with a lilac or pink tinge. One of these is *Nemacladus secundiflorus* G.T. Robbins, known from the South Coast Ranges and Greenhorn Mountains in California. He noted an unusual population (*Raven* 9138 and *Bacigalupi* 5649) from San Benito County but concluded it was not different enough to warrant recognition. Study of fresh material and additional populations indicates that the flowers of these plants consistently differ from typical *secundiflorus* in being much smaller and in having a narrower corolla tube.

Nemacladus secundiflorus var. *secundiflorus* has flowers with a white corolla, sometimes with pinkish veins, tube 2.5–3.5 mm long, broadly cylindrical, upper 2 lobes widely spreading, 2–2.5 mm long, glabrous to hairy, lower lobes reflexed, 2.5–3 mm long; filaments ± 2–2.5 mm long, anthers 0.5–0.7 mm long, with many long, ca. 0.7 mm hairs. South Coast Ranges in Monterey and San Luis Obispo counties, and the Greenhorn Mountains in Tulare and Kern counties.

Nemacladus secundiflorus* var. *robbinsii Morin, var. nov. TYPE: CALIFORNIA. SAN BENITO CO.: just W of the junction to Pinnacles on the road from Hollister to Bitterwater, 5 May 1956, *Raven, Stebbins, et al.*, 9138 (HOLOTYPE: JEPS 14554! ISOTYPES: DSI, JEPS 78490!, NY!, RSA!, SBBG!, SLO!, US!).

A *Nemacladus secundiflorus* Robbins var. *secundiflorus* flores parvioribus, corollae tubus 0.5–0.8 mm longus, lobis 0.3–0.5 mm longus, antherae 0.1 mm longus differt.

Corolla white or pale lavender; tube 0.5–0.8 mm long, narrowly cylindrical, upper 2 lobes spreading, 0.3–0.5 mm long, glabrous, lower lobes reflexed, 0.3–0.5 mm long; filaments ± 0.8 mm long, anthers 0.1 mm long, hairs absent or few, ca. 0.5 mm long. South Coast Ranges in San Benito, San Luis Obispo, and Ventura counties with one population in the Greenhorn Mountains in Tulare Co.

Etymology.—Variety *robbinsii* is named in honor of Guy Thomas Robbins, 1916–1960, in recognition of his careful and perceptive studies of *Nemacladus*. He received a B.S. from the University of California, Berkeley and an M.S. at University of Colorado, Boulder, after which he was on the faculty at University of Arizona and at Oklahoma State College, Ada. He then entered the Ph.D program at University of California, Berkeley and in 1952 took a full-time position as a Research Botanist in the Jepson Herbarium. In addition to his work on *Nemacladus*, he published a revision of North American *Androsace* (Robbins 1944). Additional information about his life can be found in the memoirs of Lavinia Pearl Butler Robbins (1882–1985), his mother, who donated her memoirs in 1972 to the Bancroft Library at University of California, Berkeley, in his memory.

Nemacladus calcaratus Morin, sp. nov. TYPE: CALIFORNIA. TULARE CO.: S of Chimney Creek Campground, ca. 9.3 air mi W of Hwy 395, sandy flats between granitic boulders, near 35.83N, 118.04W, 1745 m, 4 Jun 2008, *Morin* 641 (HOLOTYPE: ASC!; ISOTYPE: UC!).

Species corollae calcaratus a congeneribus diversa.

Plants 2–4 cm tall, branched from base or 0.5–1 cm from base, axis somewhat zig-zagged, stems widely spreading at a 60–75° angle to axis, sparsely hairy; internodes 0.5–1 cm. Basal leaves green with reddish margins, narrowly lanceolate to spatulate, 2–5 × 0.2–1.5 mm, remotely toothed, densely hairy, apex acute. Bracts 1–1.2(–2) mm long, ovate-lanceolate, entire or remotely and minutely toothed, sparsely hairy, ± clasping pedicel at base, abruptly arched away from pedicel 1/3 to 1/2 from base, apex minutely apiculate; pedicels straight or arched, 1–1.2 cm long, ± densely hairy at base, more sparsely hairy distally. Flowers bilaterally symmetrical, not resupinate; hypanthium tube hemispheric to broadly obconic, ca. 0.5 mm long; calyx lobes lanceolate, glabrous, lowest calyx lobe reflexed and appressed at base to spur, 1.2–1.5 × 0.5 mm, 2 flanking lobes 1.2–1.5 mm long, upper 2 lobes 0.8–1 mm long; petals radiating on adaxial (upper) side of corolla, white with longitudinal red or maroon line on proximal half, ovate, apex acute, bearing slender,

0.4 mm, downward pointing hairs abaxially and adaxially, lowest 2 petals connate basally 1 mm forming a spur, free portion 2.5×1.5 mm, 2 flanking and uppermost petals narrower, ca. 2.5×1 mm; filaments connate in distal 2/3, 1.8–2 mm, bearing 0.5–1 mm long hairs at apex, 2 narrow, yellow, stipe-like appendages extending from near base of filaments terminated by semicircular pad from which 8–12 clear, narrow, acute cells ca. 0.3 mm long radiate, anthers 0.3–0.4 mm; ovary subinferior, broadly hemispheric, base obtuse, apex nearly flat, 3 glands alternating with filaments low, oblong, densely papillate; capsule ca. 3 mm long, calyx lobes splayed outward.

Nemacladus calcaratus is known only from the Chimney Creek area, Tulare County, California at the southern end of the Pacific Crest.

Etymology.—*Calcaratus* is in reference to the nectar spur. Ertter et al. (6331) noted the red stripes on the corolla, and Boyd and Bramlet (1931) pointed out the small spur. It is the first species of *Nemacladus* known to have a definite nectar spur, although the corolla of *Nemacladus ramosissimus* Nutt. is gibbous. The flat ovary apex and relatively large corolla with all petals arranged on the upper part are also distinctive.

Other specimens seen: **CALIFORNIA. Tulare Co.:** 24 air mi ENE Kernville, ridge S of Chimney Creek Campground, at W end of ridge, elev. 6200 ft, 9 Jun 1986, Ertter, Holland, and Dains 6331 (RSA, UC); Southern Sierra Nevada, Chimney Creek Canyon, north Slope Peak 7155, south Chimney Meadow, elev. 6800 ft, 9 Jun 1986, Boyd & Bramlet 1931 (CAS, RSA).

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